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Appeal Brief

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of Atty. Docket

CORNELIS W.A.M. VAN OVERVELD ET AL PHN 16,341

Serial No.: 09/067,910 Group Art Unit: 2671

Filed: April 28, 1998 Examiner: P. Stevenson

Title: METHOD OF DISPLAYING AN OUTPUT IMAGE OF A SCENE FROM FREELY SELECTABLE VIEWPOINT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Enclosed is an original plus two copies of an Appeal Brief in the above-identified patent application.

Please charge the fee of $300.00 to Deposit Account No. 14-1270.

Respectfully submitted,

By Russell Gross
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CERTIFICATE OF MAILING

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APPEAL BRIEF

Sir:

The final rejection of Claims 1-11 is hereby being appealed, which are reproduced in the attached Appendix.

1. Real Party in Interest

The real party in interest is U.S. Philips Corporation, the assignee herein.

2. Related Appeals and Interferences

The Appellant is not aware of any appeals or interferences that relate to the present application.

3. Status of all Claims

Claims 1-11 were submitted in the original application. Claims 1-11 were finally rejected in the Office Action dated October 25, 2000 and are currently being appealed.

4. Status of Amendments

An After Final Amendment mailed January 17, 2001, was filed. In an Advisory Action dated February 21, 2001, it was stated that this After Final Amendment would be entered upon filing of a Notice of Appeal and an Appeal Brief.

5. Summary of the Invention

The present invention is directed to a method and device for displaying an image of a scene from a freely selectable viewpoint. As can be seen from Figure 1, the invention includes obtaining input images of the scene, each from a respective input viewpoint 14a,b, as described on page 4. As can be seen from Figure 3, the invention includes computing model information representing points 10a,b 11,a,b located in a space of the scene from which input information in the input images originate, as described on page 4.

As can be seen from Figure 4, the invention includes selecting the selectable viewpoint 40, as described on page 6. As further described on page 6, the invention includes determining for an output pixel in the output image which output point represented in the model information is visible in the output image at that output pixel 42. Further, determining a pixel value of that output pixel from the image information in the input image or input images which originated from the output point, as described on page 6. Also,

displaying 48 the output pixel in the output image according to the pixel value, as described on page 8.

As can be seen from Figure 3, the invention also includes computing a respective model for each input image, the respective model comprising information about surface patches 10a,b 11a,b located in the space of the scene, substantially each surface patch corresponding to a respective set of pixels in the respective image, as described on page 4. As can be seen from Figure 4, the invention includes determining 42 for each respective model, which if any, respective point from the surface patches of that respective model is visible in the output image at the output pixel according to that respective model, as described on page 6.

The invention also includes selecting 44 the output point from the respective points on the basis of comparison of parameters of the surface patches containing the respective points in different models for which the respective points have been found, as described on page 8. As further described on page 8, determining the pixel value from the image information in the input image corresponding to the respective model from which the output point is selected.

6. Issues Presented for Review

The first issue is whether Claims 1, 2 and 8 under 35 USC 102(a) as anticipated by or, in the alternative, under 35 USC

103(a) are unpatentable over Chen (Chen et al. 1993, entitled "View Interpolation for Image Synthesis", ACM, pages 279-286). The second issue is whether Claims 4-7 and 9-11 under 35 USC 103(a) are unpatentable over Chen. The third issue is whether Claim 3 under 35 USC 103(a) is unpatentable over Chen in view of Debevec (Debevec et al., entitled "Modeling and Rendering Architecture from Photographs", Computer Graphics Proceedings, Annual Conference, 1996).

7. Grouping of the Claims

The Appellant respectfully submits that claims 1-11 either stand or fall together.

8. Arguments

Claims 1, 2 and 8 stand finally rejected under 35 USC 102(a) as anticipated by or, in the alternative, under 35 USC 103(a) as being unpatentable over Chen. Claims 4-7 and 9-11 stand finally rejected under 35 USC 103(a) as being unpatentable over Chen. Claim 3 stands finally rejected under 35 USC 103(a) as being unpatentable over Chen in view of Debevec.

In order to make a proper obvious rejection under 35 U.S.C. 103, MPEP Section 706.02(j) requires that the prior art reference (or references when combined) must teach or suggest all of the claim limitations. Further, either the references must expressly

or impliedly suggest the claimed invention. Ex parte Clap, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985)

In view of the above, it is respectfully submitted that Chen neither expressly nor impliedly suggest al of the features recited in the claims. In particular, such features include "computing a respective model for each input image, the respective model comprising information about surface patches located in the space of the scene, substantially each surface patch corresponding to a respective set of pixels in the respective input image", as recited in Claims 1 and 8.

In addressing the above feature in the above rejections, page 2, left column, lines 14-21 of Chen is being relied on. In this portion, Chen discloses pixel correspondence can be established by if range data and the camera transformation are available.

However, in page 2, left column, lines 5-12, Chen discloses:

"Our method uses the camera's position and orientation and the range data of the images to determine a pixel-by-pixel correspondence between images automatically. The pairwise correspondence between two successive images can be pre-computed and stored as a pair of morph maps. Using these maps, corresponding pixels are interpolated interactively under the user's control to create in-between images."

In view of the above disclosure, it is evident that that the pixel correspondence disclosed on page 2, left column, lines 14-21 of Chen is between two successive images. Therefore, it is evident

that Chen does not disclose "computing a respective model for each input image", as required by the claims.

In the Office Action dated October 25, 2000, the Examiner stated that Chen does disclose creating a model of the scene in terms of pixels with range data. In response, the Applicant respectfully submits that even if the Examiner's interpretation of Chen is correct, it still does not read on the above mentioned feature.

Claims 1 and 8 require "obtaining input images of a scene, each from a respective viewpoint" and then "computing a respective model for each input image". Therefore, the claims require computing a respective model for each of the different input images of scene.

However, in page 2, left column, lines 2-7, Chen only discloses to determine a pixel-by-pixel correspondence between images automatically." Based on this disclosure, it is evident that Chen does not disclose "computing a respective model for each input image", as required by the claims. Therefore, it is respectfully submitted that this feature is distinguishable over Chen.

It is also respectfully submitted that Chen neither expressly nor impliedly suggests "selecting the output point from the respective points on the basis of comparison of parameters of the surface patches containing the respective points in different models" as recited in claims 1 and 8. In addressing this feature

in the above rejection, page 3, left column, lines 46-61 of Chen is being relied on.

However, in page 3, left column, lines 46-61, Chen only discloses:

"To generate an in between view of pair of images, the offset vectors are interpolated linearly and the pixels in the source image are moved by the interpolated vector to their destination...The interpolation is an approximation of the transformation of the pixel coordinates by a perspective viewing matrix..."

Based on the above disclosure, it is evident that Chen does not disclose "selecting the output point from the respective points on the basis of comparison of parameters of the surface patches containing the respective points in different models", as required by the claims. Therefore, it is respectfully submitted that this feature is also distinguishable over Chen.

The above-described deficiencies of Chen are also not addressed by Debevec since this reference is being relied on for other features. Thus, it is respectfully submitted that the invention of claims 1-11 is not obvious over Chen alone or in combination with Debevec. Accordingly, the Appellant respectfully requests that the final rejection of these claims be reconsidered and reversed.

Please charge the fee of $300.00 to Deposit Account No. 14-1270.

Respectfully submitted,

By _____
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A P P E N D I X

1. A method of displaying an output image of a scene from a freely selectable viewpoint, the method comprising the steps of

- obtaining input images of the scene, each from a respective input viewpoint;
- computing model information representing points located in a space of the scene from which input information in the input images originates;
- selecting the selectable viewpoint;
- determining for an output pixel in the output image which output point represented in the model information is visible in the output image at that output pixel;
- determining a pixel value of that output pixel from the image information in the input image or input images which originated from the output point;
- displaying the output pixel in the output image according to the pixel value,
- computing a respective model for each input image, the respective model comprising information about surface patches located in the space of the scene, substantially each surface patch corresponding to a respective set of pixels in the respective input image;

- determining for each respective model which, if any, respective point from the surface patches of that respective model is visible in the output image at the output pixel according to that respective model,
- selecting the output point from the respective points on the basis of comparison of parameters of the surface patches containing the respective points in different models for which the respective points have been found;
- determining the pixel value from the image information in the input image corresponding to the respective model from which the output point is selected.

2. A method according to Claim 1, wherein for selecting the output point from the respective points, preference is given to respective points with smaller distance to the selected viewpoint.

3. A method according to Claim 1, wherein for selecting the output point from the respective points, preference is given to respective points with smaller difference between a first and second angle between a normal of the surface patch to which the respective point belongs and lines of sight to the respective point, from the selected viewpoint and the respective viewpoint of the input image corresponding to the respective point respectively.

4. A method according to Claim 1, for selecting the output point, preference is given to respective points with smaller difference between a first and second size of a projection of the output pixel in the output image and an input pixel in the input image corresponding to the respective point respectively, when the output pixel and the input pixel are back-projected onto the surface patch.

5. A method according to Claim 1, wherein for each particular input image an ordered list of intervals in the output image is computed, the intervals corresponding to segments of respective surface patches successively visible along a scan-line in the output image, the scan-line containing the output pixel, the output point being determined by determining the interval in which the output pixel lies, and wherein the ordered list is computed by processing the line-segments successively in an order in which they are visible along a path in the particular input image, a representation being kept of a continuous range along the scan-line spanned by the intervals of processed line-segments, a foreground/background position of a line-segment being determined by comparing the line-segment to an auxiliary line segment extending between points in the model corresponding to the endpoints of the continuous range.

6. A method according to Claim 1, wherein altered pixel values are computed for pixels of the input images, so as to represent the effect of lighting changes, the method comprising

- selecting a source point in the scene and a lighting distribution image located relative to the source point, a respective lighting pixel value being associated with each light pixel in the lighting distribution image;
- determining for each respective model which, if any, respective lighting point from the surface patches of that respective model would be visible in the lighting distribution image at a light pixel according to that respective model,
- selecting an alterable point from the respective lighting points on the basis of comparison of parameters of the surface patches containing the respective lighting points in different models for which the respective lighting points have been found;
- altering the image information in the input image corresponding to the respective model from which the alterable point is selected at an alterable pixel corresponding to the alterable point.

7. A method according to Claim 1 comprising

- obtaining further input images from a further scene, each from a respective further viewpoint in combination with a respective

further models comprising information about surface patches located in a space of the further scene, substantially each surface patch corresponding to a respective set of pixels in the further input image;

- designating a collection of further surface patches from the further models;

- selecting a position and attitude for the collection of further surface patches relative to the further scene;

- determining respective auxiliary viewpoints relative to the further scene so that each of the respective auxiliary viewpoints has a same spatial relation to the further surface patches as a respective one of the viewpoints when the further surface patches are located according to the selected position and attitude;

- computing a set of auxiliary images of the further surfaces in the collection from the auxiliary viewpoints and computing auxiliary models describing the further surface patches in the collection as far as they correspond to sets of pixels in the auxiliary images;

- replacing a pixel value and model information in the input images by a pixel value and auxiliary model information from the auxiliary images prior to computing the output image when a depth from the respective viewpoint of the input image to a point in the scene represented by the pixel value is greater than a depth from

the corresponding auxiliary viewpoint to a visible point on a further surface patch from the collection.

8. A device for displaying an output image of a scene from a freely selectable viewpoint, the device comprising

- memory for storing input images of the scene, each from a respective input viewpoint;
- memory for storing model information representing points in the scene from which input information in the input images originates;
- means for selecting the selectable viewpoint;
- means for determining for an output pixel in the output image which output point represented in the model information is visible in the output image at that output pixel;
- means for determining a pixel value of that output pixel from the image information in the input image or images which originated from the output point;
- a display unit receiving the pixel value for displaying the output pixel in the output image according to the pixel value,

wherein the memory for storing model information is arranged to store a respective model for each input image, the respective model comprising information about surface patches located in the space of the scene, substantially each surface patch corresponding to a

respective set of pixels in the respective input image; the device comprising

- means for determining for each respective model which, if any, respective point from the surface patches of that respective model is visible in the output image at the output pixel according to that respective model,
- means for selecting the output point from the respective points on the basis of comparison of parameters of the surface patches containing the respective points in different models for which the respective point has been found;
- means for determining the pixel value from the image information in the input image corresponding to the respective model from which the output point is selected.

9. A device according to Claim 8 wherein altered pixel values are computed for pixels of the input images, so as to represent the effect of lighting changes, the device comprising

- means for selecting a source point in the scene and a lighting distribution image located relative to the source point, a respective lighting pixel value being associated with each light pixel in the lighting distribution image;
- means for determining for each respective model which, if any, respective lighting point from the surface patches of that

respective model would be visible in the lighting distribution image at a light pixel according to that respective model,

- means for selecting an alterable point from the respective lighting points on the basis of comparison of parameters of the surface patches containing the respective lighting points in different models for which the respective lighting points have been found;

- means for altering the image information according to a lighting model in the input image corresponding to the respective model from which the alterable point is selected.

10. A device according to Claim 8, wherein the means for determining for each model which output point is visible determine for each particular input image an ordered list of intervals in the output image is computed, the intervals corresponding to segments of respective surface patches successively visible along a scan-line in the output image, the scan-line containing the output pixel, the output point being determined by determining the interval in which the output pixel lies, and wherein the ordered list is computed by processing the line-segments successively in an order in which they are visible along a path in the particular input image, a representation being kept of a continuous range along the scan-line spanned by the intervals of processed line-segments, the foreground/background position of a line-segment

being determined by comparing the line-segment to an auxiliary line segment extending between points in the model corresponding to the endpoints of the continuous range.

11. A device according to Claim 8, comprising means for

- obtaining further input images from a further scene, each from a respective further viewpoint;
- designating a collection of further surface patches from the further models;
- selecting a position and attitude for the collection of further surface patches relative to the further scene;
- determining respective auxiliary viewpoints relative to the further scene so that each of the respective auxiliary viewpoints has a same spatial relation to the further surface patches as a respective one of the viewpoints when the further surface patches are located according to the selected position and attitude;
- computing a set of auxiliary images of the further surfaces in the collection from the auxiliary viewpoints and computing auxiliary model information representing depth of the further surface patches in the collection from the auxiliary viewpoints;
- replacing a pixel values and model information in the input images by a pixel value and auxiliary model information from the auxiliary images prior to computing the output image when a depth from the respective viewpoint of the input image to a point in the

scene represented by the pixel value is greater than a depth from the corresponding auxiliary viewpoint to a visible point on a further surface patch from the collection.